Critical coincidences: The journeys of sustainable niche-innovation projects

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Critical Coincidences: the Journeys of Sustainable Niche-Innovation Projects

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Abstract
Niche-innovation projects play an essential role in the sustainable transition of the global society, but frameworks for managing sustainable niches do not resemble the actual dynamics at play in niche-innovation projects. By applying the Critical Incident Method, this paper explores the journeys of three niche-innovation projects from the Danish construction industry. The case studies find that the innovation journeys are highly influenced by a number of critical factors, of which some can be planned and managed, whereas others are coincidental and happen by chance. A stronger orientation towards the dynamics and activities in projects, so that management strategies can embrace and utilize the potentials of the critical coincidental factors, can contribute to a better understanding and potentially an acceleration of the sustainable transition process.

Keywords: innovation projects; sustainability; transition process; niche management

Introduction
The challenge of ensuring a sustainable society is essential to human kind, and at the same time an extremely difficult task. Society – citizens, politicians, companies etc. – tend to sit on their hands in the fight against climate change, awaiting others' actions and in the meanwhile continue practice as usual. Since the dangers of climate change are not immediate or directly visible in our daily lives, many of us will stay passive until the dangers become so critical and so present that we cannot keep our eyes closed anymore. And at that time, serious action will be too late. Giddens (2011) calls this menacing situation *Giddens's paradox*, and argues that actions towards creating a sustainable society must build on the fact that most people find it easier to engage in the present than in the future.

In the built environment, the need for addressing *Giddens's paradox* is profound as buildings and the construction industry together are responsible for 36% of the energy consumption and 39% of the CO2 emissions globally (UN Environment & International Energy Agency 2017). Though the paradox seems fundamental, not least in the tradition-bound and conservative construction industry, it is not impossible to confront and affect. In Norway, the introduction of 'passive houses' resulted in a rather sad debate, as people were not interested in investing and residing in buildings with restrictions on how to use and conserve energy. However, 'active houses' that produce energy have received a much warmer welcome, and the shift in focus from energy saving to energy production has had a positive psychological impact on the construction industry (Nykamp 2016). So, the transition towards a more sustainable society, and in this paper with a particular focus on the construction industry, is essential, difficult, paradoxical and manageable.

I line with this, Morris and Teerikangas (2015) have called for action for the project management community to engage in the sustainability agenda. The project management community, they claim, has retained a seeming silence regarding this topic. However, the potential for project, program and portfolio management to act as a key discipline for unlocking the challenge of climate change, and hereunder *Giddens's paradox,* is grand. In this paper, we follow that call as we wish to contribute to the societal transition towards sustainability by focusing particularly on innovation projects.

Innovation projects play a central role in the sustainable transition process. Following the Multi-Level Perspective (MLP) as a framework for understanding socio-technical transitions towards sustainability, innovations "are the seeds of transitions" (Geels & Schot 2010, p.24). The MLP (see figure 1) argues that sociotechnical transitions come about through interacting

processes within and between the existing regime, radical niche-innovations and the sociotechnical landscape (Geels 2002; Geels 2010; Rip & Kemp 1998). Niches are 'protected spaces' such as R&D laboratories, subsidized demonstration projects, or small market niches where emerging innovations can be supported (Geels 2011). In the societal transition process, niche-innovations emerge and evolve over time, and eventually, potentially, contribute to a reconfiguration of the existing regime. These dynamics of regime transitions due to interactions from the niche and the landscape level is rather well-described (see for instance (Geels 2005; Geels et al. 2016; Smith 2006)); however, the underlying processes that take place at the niche level still lack conceptual understanding (Shove & Walker 2010).

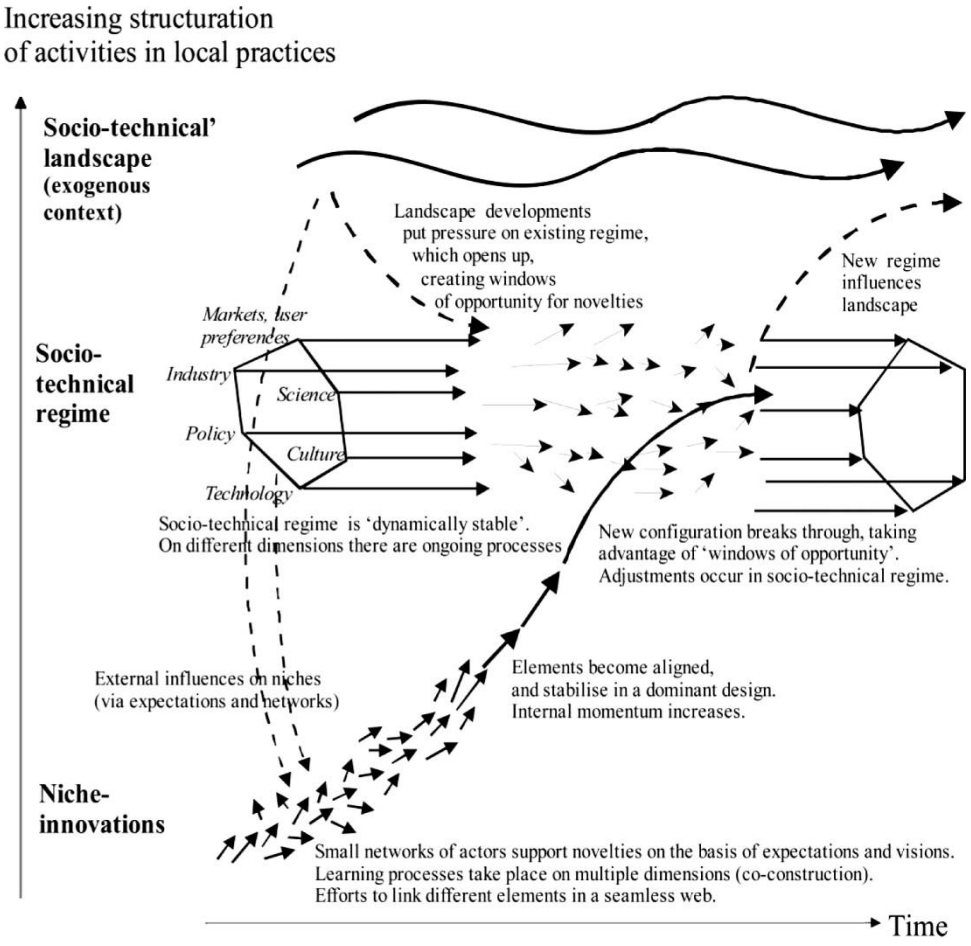

Figure 1: The Multi-Level Perspective (Schot & Geels 2008)

The project is usually the means by which innovation takes place (Brady & Hobday 2012). Much literature has described the components and development process of an innovation project, perhaps with Van de Ven et al.'s (1999) Innovation Journey (see figure 2) as a seminal cornerstone. However, we suspect that *sustainable niche-innovation* projects that furthermore hold the potential of changing the existing regime, and thus contribute to a sustainable transition, somehow act differently than the 'normal' projects upon which the Innovation Journey is based. Since sustainable innovations are targeting a highly uncertain future, they have to be reflexive, adaptive, 'fluid', aware of its consequences, and therefore open-ended (Berker 2010). Therefore, with the aim of contributing to the sustainable transition, and as a response to Morris and Teerikangas' call for action, we wish to investigate: *How do sustainable niche-innovation projects develop over time?*

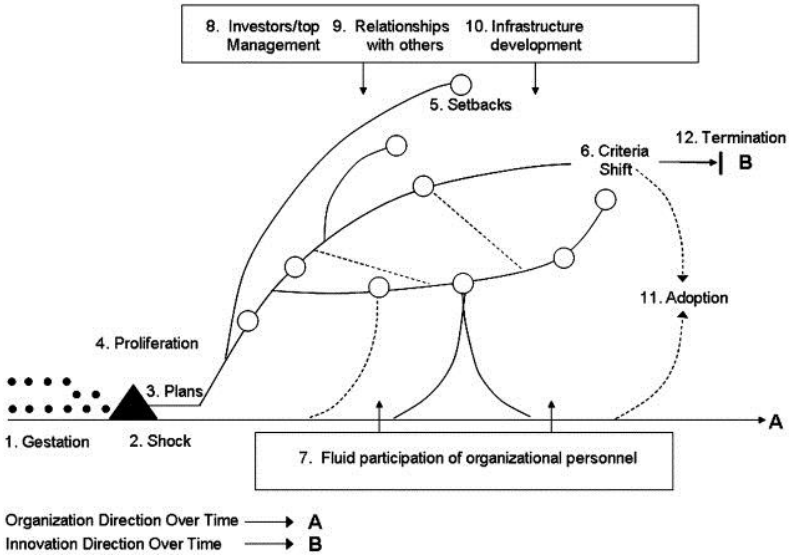

Figure 2: Key components of the innovation journey (Van de Ven et al. 1999)

Initially, the paper introduces Strategic Niche Management as a widely acknowledged theoretical understanding of niche activities and affiliated management approaches. Based on this understanding, we empirically explore the development of three niche-innovation projects by applying the Critical Incident Method to three cases within the field of sustainable construction. The findings from these cases are presented and discussed before the conclusion sums up and suggests implications for practice and further research.

Strategic Niche Management

Strategic Niche Management (SNM) is a framework for understanding and managing niche-innovations. Driven by the observation that many sustainable technologies never leave the show-rooms – or worse, remain on the shelves of laboratories as prototypes – Schot et al. (1994) and Kemp et al. (1998) performed research on early market experimentation with electric vehicles to understand why. They identified experimentation in technological niches as a crucial step in maturing innovations and noticed three interrelated processes leading to successful niche management: managing expectations, building social networks, and learning processes. (Coenen et al. 2010; Panetti et al. 2018). SNM particularly focuses on the creation, development and controlled phase-out of 'protective spaces' for experimental projects in order to nurture path-breaking innovations (Kemp et al. 1998; Smith & Raven 2012). The SNM framework is primarily targeted towards national and regional governments to help new radical innovations develop and expand by supporting a portfolio of niche projects and disseminating the knowledge that is gathered in the projects (Kemp et al. 1998; Lovell 2007).

Through the years, SNM has met a diverse range of criticism. A notable branch of critics argue that the SNM framework is too orderly and structured, that the dynamics of niche-innovations are highly complex and cannot be embraced by a singularly rational management task, and that more regards need to be paid to the messiness of socio-technical system change (Lovell 2008; Raven et al. 2016; Smith & Raven 2012). We join this choir and suggest a specific focus on the dynamics of the individual niche-innovation projects as a foundation for understanding and managing the influence of innovations on sustainable regime transitions. With this suggestion of focus, we extend Morris' (2013) proclamation that program management has an essential role to play in managing innovations within the framework of MLP. We propose that also project management is an essential discipline in the societal

transition process, a notion we will empirically explore through case studies of three sustainable niche-innovation projects.

Research design

To investigate the processes of sustainable innovation projects, in order to understand the development of such projects over time, we have conducted three case studies of sustainable niche-innovation projects. The three cases are related to the Danish construction industry, and their innovation projects hold different value propositions targeted towards the market for building materials. The cases are all examples of innovations with substantial sustainable performance, and with high potential for commercial success, i.e. the innovations provide a sustainable solution relevant to the market.

Table 1: Overview of cases

Case	Innovation	Start	Current status of innovation process
1	Lightweight concrete slabs	2009	Optimizing production
2	Reuse of old bricks	2002	Generating documentation
3	Large-scale cover of construction sites	2009	Seeking an established position on the Danish market

The first case concerns lightweight concrete slabs that reduce CO2 emissions and enable architectonic freedom. The second case involves reuse of old bricks in new buildings as an example of a circular economy solution and sustainability through upcycling. The third case innovation is a complete cover solution of building sites that provides dry weather for the construction phase and thus enables, for example, larger buildings in wood. All three cases are start-up companies with a particular innovation and its implementation at the market as their main project.

The case study is used as a research strategy to understand the dynamics present within single settings (Eisenhardt 1989). In this case, we wish to understand the dynamics at play in an innovation project's journey from starting-up to successful implementation. Case studies generate context-dependent knowledge (Flyvbjerg 2006), which narrows the extent of generalizability, and as a response to this, multiple case studies are used as they typically provide a stronger base for theory building (Yin 2014). Findings from multi-case studies are generally better grounded, more accurate, and more generalizable, and they enable comparisons that clarify whether an emergent finding is simply idiosyncratic to a single case or consistently replicated by several cases (Eisenhardt & Graebner 2007). The case studies are based on a mixed methods design (Yin 2014) including six in-depth, semi-structured interviews (Kvale 2007) performed by the authors, supplemented by three secondary source interviews (Smith Innovation 2016) from which notes have been available. Furthermore, a set of reports and documents produced by governmental authorities and professional consultancies on e.g. barriers and opportunities, technological performance assessments, and policy documents related to the three cases have produced a solid foundation for understanding the contexts of the innovation projects. The transcripts from the interviews, each lasting approximately one hour, have been coded, and the entire collection of data has been analyzed by the authors.

To explore the dynamics at play in the three cases, we have applied the Critical Incidents Method (Weatherbee 2010). This methodology is used primarily for exploratory research,

which indeed is the aim of the present study. It is a flexible qualitative or mixed methods technique used for the study of factors, variables, or behaviors that are critical to the success or failure of an activity or event and associated outcomes. We thus apply an event-based focus to our case studies to identify factors that have been critical, i.e. significant, unique or unusual, for the innovation journeys. As almost all events or critical incidents will be post hoc analyses, a combination of evidentiary material has been used within the case studies. Furthermore, we acknowledge in our study that critical incident method based cases should be considered only analytically generalizable. That is, the results of the study may provide an analytical or propositional framework within which other, perhaps similar, events or incidents can be analyzed.

The critical incidents method has been applied on the analysis of the collected data, and based on this an illustrative map of the critical factors for each of the three cases have been produced. Figure 3 shows an example of such illustrations. These maps have formed the basis for the following analysis and presentation of findings.

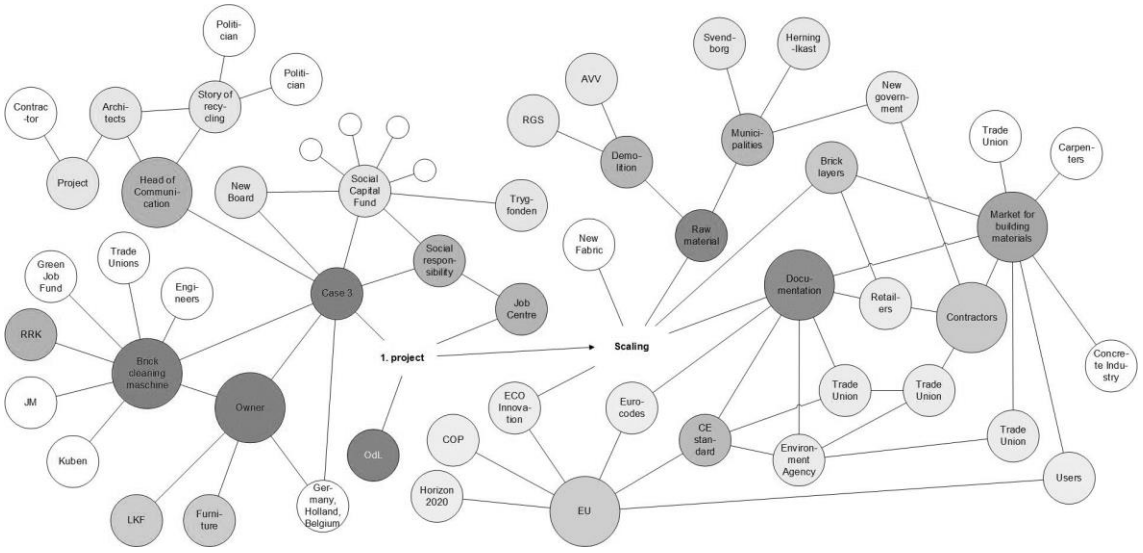

Figure 3: Illustrative map of the critical factors for case 2 (reuse of old bricks).

Case descriptions

The three innovation projects have all journeyed from a starting-up position with not much more than a good idea of an innovative technology towards an entry at the market for building materials in Denmark. As noted in table 1, at the time of writing, not all cases are yet firmly established at the market, however all have experienced to have their innovation sold to and implemented in notable large-scale building projects. Following the critical incident method and with inspiration from the project management field, the descriptions of the cases' innovation journeys will focus on critical factors for (1) the innovation itself (the product), (2) the journey of the project from niche towards the existing regime (the process), and (3) the actors involved in initiating, developing and implementing the innovation (the people).

Case 1: Lightweight concrete slabs
In 2009, three entrepreneurial business students, who found school too theoretical, wanted to start a business together. One's father was a professor in concrete structures and had invented a new technology for lightweight concrete slabs with promising commercial potential. However, the professor did not intend to become an entrepreneur himself, so the three students founded a company that further developed and commercialized the innovative technology. The university, where the technology initially was invented, required that the three entrepreneurs collaborated with a specific investor in order to have the innovation and its intellectual property rights transferred.

With the investor, further funding for the start-up of the company was established, and a CEO and an engineer were hired. The engineer had a great passion for the innovation and initiated a process for refining both the product and the production procedure, and for generating the necessary performance documentation together with numerous consultants from universities, private companies and research and technology organizations. Meanwhile, the three entrepreneurs focused on obtaining further funding and on selling their product to architects and contractors to have it implemented in building projects. The CEO established a partnership with a concrete manufacturer already established on the market, and hereafter the product was sold to three large-scale building projects.

However, the three entrepreneurs were displeased with the engagement and performance of the CEO, and eventually the board decided to replace him. A new CEO has hired, but shortly hereafter an essential funding agreement was cancelled and the company declared itself bankrupt. Still, the innovation behind the company, the product, was well functioning and the clients were pleased. The three entrepreneurs, who were now reduced to two due to illness, together with the engineer and the new CEO formed a new company in partnership with the manufacturer. The connection to the manufacturer, who was an established and acknowledged actor on the market for building materials, supported the credibility of the new company and thus influenced the innovation to be sold and implemented in further building projects both in Denmark and abroad. The main influential factors in the innovation journey of the concrete case are collected in table 2.

Table 2: Critical factors in case 1

Product	**Process**	**People**
The professor's invention	The three entrepreneurs' drive for establishing a company	The university's requirement of partnership with the investor
The engineer's engagement in developing the innovation	The demission of the CEO	The investor's employment of the CEO
The consultants' assistance in the development process	The partnership with the manufacturer positioned at the existing market	
Funding for development and market entrance	The market's reluctance to new building materials	
	The new CEO's engagement in the new company	

Case 2: Reuse of old bricks

The innovative technology in this case cleans off mortar from old bricks via vibrations so that no chemicals or hazardous substances are left, and thus enables the old bricks to be reused for the benefit of both the environment and the aesthetics of the buildings. The technology was invented by an impassioned entrepreneur who did not manage to utilize its commercial potential, and thus the sales manager took over the company and the technology and became the CEO. Using the technology, he started cleaning bricks by himself until one day a large property developer called and asked for 40.000 bricks for one of their renovation projects. To execute this order, the CEO had to have a staff, and in collaboration with the local municipality, he hired a couple of employees with wage subsidy. This became the start of the social responsibility profile of the company, who now employs refugees, vulnerable youngsters and disabled people. In line with this, the company formed a partnership with a social venture fund. This partnership raised the credibility and reputation of the company, as the social venture fund attracts many renowned investors and costumers.

To develop the innovation and particular to enter the market for building materials, the company raised further funding, e.g. from the EU who had several focus areas within the circular economy agenda. One of the main challenges to solve was to gain proper documentation that the old bricks were sound and safe to use in buildings. Several actors from the existing industry, for example the tile works producing new bricks and the trade organizations representing them, had loudly demanded specific certifications of reused building materials. After years of determined effort, the old bricks recently gained the requested certificate and can now document its environmental and structural performance on the same terms as new bricks.

Another obstacle in the innovation journey of the reused bricks project was to gain access to the old bricks. The demolishers, from whom the old bricks were purchased, had already established optimized procedures for tearing down buildings and sorting materials, and they had created a decent business model in reselling the demolished materials as road filling. To have the old bricks specifically sorted out would require more man-hours, and consequently the demolishers demanded a higher price, which raised the price for the reused bricks considerable. Alternatively, the old bricks could be purchased from the municipalities who operate the recycling centers. An agreement with several municipalities were in place when a change of Government resulted in a far more liberal policy for waste management, and the arrangement fell through.

Recently, a new partnership with several recycling organizations has been established to secure the access to old bricks, and the company has experienced a breakthrough in delivering to larger building projects in the range of 600.000 bricks. The revenues of the company are increasing, but there is still some way to go in order to reach the full potential, which is estimated to 47 million reused bricks per year, and today the company realizes three million bricks. So the innovation journey for the reused bricks continues.

Table 3: Critical factors in case 2

Product	**Process**	**People**
The entrepreneur inventing the technology	The property developer who placed the first large order	Employment of wage subsidy staff, initiating the social responsibility profile
The technology for cleaning old bricks	The existing market's reluctance to new types of materials	The partnership with the social venture fund, generating credibility for the company
Funding for development and market entrance	The circular economy agenda, raising awareness of the innovation	
Gaining the documentation certificate	The challenge of generating proper documentation	
	The challenge of gaining access to the old bricks	
	Change of Government, liberalizing the market for waste	

Case 3: Large-scale cover of building sites
The idea for the innovation in case 3 came as a result of a fortuitous meeting between a stage builder from the entertainment industry and an engineer specialized in lightweight, module-based buildings. The engineer instantly saw the potential of transferring the large-scale structures from the stage to the building site as a complete cover solution that, for instance, could enable larger buildings in wood. The stage builder quickly caught the idea and refined the structures and the set-up procedures to match the requirements for a building site.

The main challenge in this innovation journey was to find investors, as the structure was rather expensive upfront but profitable in the long run. The company received funding for market maturity with the requirement of having the innovation implemented in a building project within a set period of time. The team sold their idea to a large contractor but close to the deadline, the arrangement fell through. Instead, the stage builder rushed to get in contact with previous collaborators from the music industry, and shortly after, and within deadline, they had their construction set up for a concert at Wembley Stadium.

The market maturity funding was further geared with private and public funding, as the banks were not interested in investing in the project. Through one of the private funding organizations, the team met the construction manager of a hospital that was about to be rebuild. Later, on the golf court, the engineer met the contract manager of the same building project, and they ended up with a significant order for that project which indeed established them in the market for building materials. Before that, on the football field, the engineer had run into an old friend from university who now worked at a large consultancy company. The consultant had by chance seen a mock-up of the structure at Wembley, and he was very interested in the concept. Thus, the innovation was implemented in a large office-building project.

Table 4: Critical factors in case 3

Product	Process	People
The meeting btw. the stage builder and the engineer, initiating the innovation	The banks' reluctance to offering loans, causing a dependency on private and public funding	The stage builder's old connection in the music industry, resulting in the Wembley project Meeting at the football field, resulting in the office project Meeting at golf court, resulting in the hospital project

Analysis of innovation journeys

Looking across the three cases, we find examples of innovation journeys where the technology behind the innovation was invented beforehand and not directly by the case companies. The cases are thus not representing journeys from idea to product, but from product to market – in other words, from niche to regime. Along these journeys, several incidents have happened that have shaped the product design and performance, the process towards implementation and the people involved over time. Some critical incidents or factors are found in all three cases, and some only appear once. But more interestingly, we find two categories of factors in all three cases; the factors or incidents that can be foreseen, planned and managed, and the incidents that happen by chance or coincidentally.

Manageable factors

First, we find the incidents where entrepreneurial types realize the potential of a technology or innovation of becoming a commercial and sustainable success. The three entrepreneurs located the professor's technology in the concrete case, the sales manager saw the potential of cleaning old bricks, and the stage builder and the engineer realized the possibilities of transferring stage constructions to building sites. The management task here is to see the innovative potentials in an existing technology and then plan a process for developing, refining and adapting the technology to become relevant for and saleable to the market.

Hereafter, obtaining funding is essential to support the journey onwards, i.e. the process of developing and producing the innovation and getting it implemented on the market. Each step takes time and hard work, and requires financial support. Funding often comes with specific restrictions for and influence on the innovation project both in terms of the product, the process and the people involved. In the concrete case and the old bricks case, funding was achieved for the refinement of the product so that it could enter the market with restrictions for e.g. specific types of documentation to be generated. In the site cover case, the process was influenced by the funding factor due to implementation requirement within a specific timeframe, which steered the project towards a focused search for a building site to cover, ending with the Wembley project. Finally, also in the concrete case, the investor influenced the innovation organization by hiring a CEO that did not live up to the expectations. Managing the funding requirements is thus essential both in terms of securing the value of the product, the direction of the process and the involvement of the people. And above all, to get financial support of the project.

With the innovation developed and refined, and the funding secured and its requirements addressed, the direction of the journey turns towards entering the market. Here, a critical factor is the existing regime, i.e. the actors already established in the market, their norms and values, and their existing procedures. In the old bricks case, we saw that the tile works and their organization set up high demands for documentation of the performance of the old bricks, which took time and effort for the company to achieve. In the concrete case, the existing market also acted reluctantly towards the entrance of new types of building materials. To deal with this, the company formed a partnership with a manufacturer already established in the market, which gave them the necessary credibility. So, useful strategies for managing the existing regime actors is to do as they say by gaining the necessary documentation and join the them by establishing partnerships.

Finally, when the innovation is developed, the funding is in place and the existing regime on board, the path is clear for implementation. In the three cases, getting involved in a large-scale building project is the alpha and omega for the success of the innovation. This dependency on other projects might be unique for the construction industry, however, in the end, it is about finding a client to your innovation and make a sale. As we saw in the old bricks case, the first big sale can make all the difference. To them, it meant hiring staff and accelerating both the production and the cultural development. In the site cover case, first the office-building project and thereafter the hospital project where significant factors for their establishment on the market. Thus, getting in on an important project or selling the innovation to an actor of consequence is highly critical for the innovation journey.

Coincidental factors

Across the three cases, we observed a number of incidents or factors that largely influenced the innovation journeys, but that was not directly possible to plan or manage. These factors, that somehow happened by chance and at the same time took the innovation project in a new direction, we characterize as coincidental factors.

Fortuitous meetings have had a great impact on the projects and its journeys in both case 2 and 3. In the old bricks case, the CEO's meeting with the municipality when he initially needed to hire staff resulted in a social responsibility profile of the company due to the hire of socially marginalized people on wage subsidy. This led to a partnership with a renowned social venture fund, which generated credibility and publicity of the company. The meeting with the municipality, of course, was planned, but the outcome and its derivative effects could not have been foreseen by the CEO. Also, in the site cover case, the meeting between the stage builder and the engineer, igniting their innovation journey, was purely coincidental. The engineer happened to drive by a site, where the stage builder was at work, had a bright idea, stopped the car and went over to have a talk. This meeting could not have been planned, but they both saw the potential of merging their professions and their innovation journey began.

Another coincidental factor observed is the personalities of actors central to the innovation project. In the concrete case, the engineer's genuine engagement in and passion for the innovation drove the development process forward, resulting in a refined product and an optimized production. His personality, of course, was an essential part of why he was hired in the first place, but as with any employment, it is a gamble whether the person you hire will actually perform as you expect, or, as in this case, over-perform and to a high degree add value to your project. Generally seen, the concrete case is an example of an innovation project highly influenced by personalities. The drive and fighter-will of the three

entrepreneurs has indeed been the fuel for the journey. On the contrary, the lack of engagement of the CEO, resulting in disappointing sales figures and internal dispute, slowed down the pace of the project.

A third essential factor that is both highly influential on the innovation projects studied and difficult to plan ahead is personal connections. In the site cover case, the three main building projects where the innovation initially was implemented, which triggered funding and professional recognition, came into being due to personal connections. First, the stage builder's connection in the music industry resulted in the Wembley project. Second, the old school mate, the engineer met at the football field, led to the office-building project. And third, the rendezvous at the golf court opened up for the hospital project. The stage builder and the engineer were keen to make use of their personal connections when the opportunities arose, but the portfolio of friends, family, acquaintances and former co-workers and their potential influence on the innovation project is highly difficult to construct and manage upfront.

The fourth coincidental factor, observed in multiple cases, we characterize as the landscape factor. Referring back to the Multi-Level Perspective model in figure 1, the landscape constitutes the broad, external context for the existing regime and niche activities, such as cultural norms and values or slowly changing broader social structures (Geels 2011; Rohracher & Späth 2014). The landscape factors observed in the cases are thus examples of political incidents or societal trends that have influenced the innovation projects but without any chance for the project teams to interfere conversely. In the old bricks case, the project happened to benefit greatly from the rising focus in the Danish society and particular in the EU on the circular economy agenda. When the company started its journey in 2002, this agenda was not very apparent, but as the awareness of sustainability and sustainable living rose, so did the circular economy agenda. The old bricks project also experienced the negative effect of landscape factors, when a change of Government liberalized the waste market, complicating the process of getting access to old bricks. Likewise, in the site cover case, the repercussions of the financial crisis meant that the banks were reluctant to offer them loans to support the innovation project, causing a dependency on private and public funding and with that an acceptance of the terms not particular beneficial for the project.

These four coincidental factors observed across the three cases are, opposed to the manageable factors, very hard to implement in the planning and management procedures of an innovation project. However, they play a very significant role, influencing the innovation journeys studied in both a positive and negative direction. In the cases, these factors have been managed or dealt with rather pragmatically by exploring the opportunities and new scenarios caused by the incidents and just *go with it*. This managerial approach, to go with it, can actually be applied to all four observed coincidental factors. If you by chance meet someone interesting, and you sense a potential fruitful interplay, go with it – perhaps it is love! The personalities of actors central to the project can be a make-or-break-factor for the project, so the project manager must make sure to benefit from the positive energy and deal with the opposing forces. Personal connections can save your project, so use them wisely, and finally, you cannot hinder landscape factors to influence the project, so just go with the flow.

The findings from the three case studies, the managerial and coincidental factors that have influenced the innovation journeys and how they have been managed, are presented in table 5.

Table 5: The manageable and coincidental factors found in the three cases

Manageable factors			
Existing technology *See the potential, develop, refine, adapt*	Funding *Follow the rules of the game*	Existing regime *If you can't beat them, join them!*	Implementation *Get in on significant projects*

Coincidental factors			
Fortuitous meetings *Could it be love?*	Personalities *It can make or break you*	Personal connections *Your savior might be on the golf court*	Landscape factors *Go with the flow*

Discussion

The three case studies of the niche-innovation projects showed that several factors or incidents critically influenced the journeys of the projects. Some factors were manageable and could to some extent be planned upfront, whereas other factors were coincidental and happened by chance, and their influences on the project had to be managed as they occurred. Due to these ongoing critical incidents, the journeys of the projects became highly dynamic with varying obstacles to overcome, changes in the context, both at the regime and landscape levels, to adapt to, and new set-ups in the project organization to deal with. The findings from the case studies suggest that the management strategies of sustainable niche-innovation projects must be largely agile and adaptable in order to keep the project on track when random factors knock it off course or generate a favorable tailwind. Such strategies must be able to adapt to unknown critical factors and be prepared for sudden changes in the project, regarding both the product, the process and the people. In the cases, the pragmatic strategies have broadly been to *go with it*. The case companies are all small start-ups who neither have the power or resources to go against the critical factors, nor do they have the experience or means to set up a specific strategy for managing the critical coincidental factors. Instead, they allow the projects to follow where the incidents lead, and though the deviations take time and resources, the projects in general became stronger by the influence of the critical factors.

The findings from the case studies support the critique of the Strategic Niche Management (SNM) initially addressed that that the dynamics of niche-innovations are highly complex and cannot be embraced by a rational management task. The dynamic, agile management approach, found at the project level, contrasts to the structure of the SNM framework that argues that three interrelated processes (managing expectations, building social networks, and learning processes) lead to successful niche management. We do acknowledge that the SNM framework primarily is targeted towards national and regional governments with the aim of helping the development of innovations by supporting a portfolio of niche projects. However, innovations happen in projects, and these projects, we have found, are dynamic and highly affected by uncertain, coincidental incidents. Based on the findings from the case studies, we thus suggest adding the project level as a foundation for niche management.

Though the suggested dynamic management approach challenges the structure of the SNM framework, the findings from the case studies also resemble the central processes of the SNM framework. The coincidental factors include examples of the importance of managing

expectation (e.g. when dealing with different personalities), building social networks (e.g. using your personal networks) and learning processes (e.g. the overall strategy of following the critical factors, exploring the opportunities and learning from the experiences). What differ the case study findings from the SNM framework is the management approach. SNM offers a structured approach to niche management including controlled development and phase-out of protective spaces for experimental projects, whereas the case study findings suggest that management of niche-innovation projects must include a high degree of flexibility in order to respond to the coincidental factors and critical incidents. We suggest that basing the understanding of niche-innovation dynamics, and with that the approach on how to manage niches, on the dynamics found at the project level can strengthen the SNM framework in becoming more practice-oriented and perhaps more effective. Further research is needed on how the dynamics and critical factors at play in niche-innovation projects in practice can influence, complement and strengthen the niche management approach. However, based on the findings, we argue that a stronger orientation towards the practical activities at the project level can contribute to a better understanding and potentially an acceleration of the sustainable transition process.

With this suggestion, we also wish to address the project management community. In line with Morris (2013), we agree that management of projects (mop) plays a significant role in the sustainable transition of the global society. However, we argue that transitions are not only supported and influenced from a policy level, focusing on strategic management of programs and portfolios. The project level is significant to consider in this process, both in terms of generating an understanding of the dynamics at play at all levels, and in terms of developing project management skills that embrace the high degree of complexity and the need for agility in niche-innovation projects.

Conclusion

The underlying aim of this paper was to investigate *how sustainable niche-innovation projects develop over time* in order to gain a solid, practice-based understanding of the dynamics at play in niche-innovation projects, and with that contribute to the literature on sustainable transitions by adding a particular focus on the role and dynamics of projects. By studying three cases of innovation projects from the Danish construction industry, we found that their innovation journeys have been highly influenced by a number of critical incidents, of which some can be planned and managed, whereas others are coincidental and happen by chance. The critical role of these coincidental factors at the project level challenges the structured approach of Strategic Niche Management (SNM) as a framework for managing and nurturing innovation niches. We thus suggest that SNM, and sustainable transition oriented program management in general, pay more attention to the dynamics and activities of projects so that management strategies become agile and flexible enough to utilize the potentials of the critical coincidental factors.

In practice, a strategy for niche management that is based on the actual activities taking place in niche-innovation projects could be a significant contribution in order to support and accelerate niche-innovations' journeys towards the regime. Moreover, there are several interesting research avenues to follow regarding the role of project, program and portfolio management in the societal transition towards sustainability. In this paper, we have focused specifically on the project level and through multiple cases shown that such studies give rise to new aspects for transition management to incorporate. Another relevant and interesting path to follow for further research is the interplay between projects, programs and portfolios in the context of sustainable transition processes. These processes are highly complex and

extremely important, not just in the construction industry, as studied in this paper, but globally and across all sectors. The project management community have an important and exciting role to play in accelerating the societal transition process, but it requires immediate action and the will to engage in the future.

References

Berker, T., 2010. Dealing with uncertainty in sustainable innovation : mainstreaming and substitution. *Int. J. Innovation and Sustainable Development*, 5(1), pp.65–79.

Brady, T. & Hobday, M., 2012. Projects and Innovation. In P. W. G. Morris, J. Pinto, & J. Soderlund, eds. *The Oxford Handbook of Project Management*. Oxford, UK: Oxford University Press, pp. 273–294.

Coenen, L., Raven, R. & Verbong, G., 2010. Local niche experimentation in energy transitions: A theoretical and empirical exploration of proximity advantages and disadvantages. *Technology in Society*, 32(4), pp.295–302.

Eisenhardt, K.M., 1989. Building Theories from Case Study Research. *Management Review*, 14(4), pp.532–550.

Eisenhardt, K.M. & Graebner, M.E., 2007. Theory building from cases: opportunities and challenges. *Academy of Management Journal*, 50(1), pp.25–32.

Flyvbjerg, B., 2006. Five misunderstandings about Case-Study Research. *Qualitative Inquiry*, 12(2), pp.219–245.

Geels, F.W., 2010. Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective. *Research Policy*, 39(4), pp.495–510.

Geels, F.W., 2002. Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. *Research Policy*, 31(8–9), pp.1257–1274.

Geels, F.W., 2005. The Dynamics of Transitions in Socio-technical Systems: A Multi-level Analysis of the Transition Pathway from Horse-drawn Carriages to Automobiles. *Technology Analysis & Strategic Management*, 17(4), pp.445–476.

Geels, F.W. et al., 2016. The enactment of socio-technical transition pathways: A reformulated typology and a comparative multi-level analysis of the German and UK low-carbon electricity transitions (1990–2014). *Research Policy*, 45(4), pp.896–913.

Geels, F.W., 2011. The multi-level perspective on sustainability transitions: Responses to seven criticisms. *Environmental Innovation and Societal Transitions*, 1(1), pp.24–40.

Geels, F.W. & Schot, J., 2010. The Dynamics of Transitions: A Socio-Technical Perspective. In J. Grin et al., eds. *Transitions to Sustainable Development : New Directions in the Study of Long Term Transformative Change*. Routledge, pp. 11–101.

Giddens, A., 2011. *The politics of climate change* 2. edition., Cambridge: Polity Press.

Kemp, R., Schot, J. & Hoogma, R., 1998. Regime shifts to sustainability through processes of niche formation: The approach of strategic niche management. *Technology Analysis & Strategic Management*, 10(2), pp.175–195.

Kvale, S., 2007. *Doing Interviews*, Sage Publications.

Lovell, H., 2008. Discourse and innovation journeys: the case of low energy housing in the UK. *Technology Analysis & Strategic Management*, 20(5), pp.613–632.

Lovell, H., 2007. The governance of innovation in socio-technical systems: The difficulties of strategic niche management in practice. *Science and Public Policy*, 34(1), pp.35–44.

Morris, P.W.G., 2013. *Reconstructing project management*, Chichester, England: Wiley-Blackwell.

Morris, P.W.G. & Teerikangas, S., 2015. Addressing the challenge of climate change: The power of portfolio, program and project management. In *7th IRNOP conference*. London.

Nykamp, H., 2016. A transition to green buildings in Norway. *Environmental Innovation and*

Societal Transitions, In Press,.
Panetti, E. et al., 2018. What drives technology transitions? An integration of different approaches within transition studies. *Technology Analysis and Strategic Management*, 0(0), pp.1–22.
Raven, R. et al., 2016. Niche construction and empowerment through socio-political work. A meta-analysis of six low-carbon technology cases. *Environmental Innovation and Societal Transitions*, 18, pp.164–180.
Rip, A. & Kemp, R., 1998. Technological Change. In *Human choice and climate change*. Battelle Press, pp. 327–399.
Rohracher, H. & Späth, P., 2014. The Interplay of Urban Energy Policy and Socio-technical Transitions: The Eco-cities of Graz and Freiburg in Retrospect. *Urban Studies*, 51(7), pp.1415–1431.
Schot, J. & Geels, F.W., 2008. Strategic niche management and sustainable innovation journeys : theory, findings, research agenda, and policy. *Technology Analysis & Strategic Management*, 20(5), pp.537–554.
Schot, J., Hoogma, R. & Boelie, E., 1994. Strategies for shifting technological systems. The case of the automobile system. *Futures*, 26(10), pp.1060–1076.
Shove, E. & Walker, G., 2010. Governing transitions in the sustainability of everyday life. *Research Policy*, 39(4), pp.471–476.
Smith, A., 2006. Green niches in sustainable development: The case of organic food in the United Kingdom. *Environment and Planning C: Government and Policy*, 24(3), pp.439–458.
Smith, A. & Raven, R., 2012. What is protective space? Reconsidering niches in transitions to sustainability. *Research Policy*, 41(6), pp.1025–1036.
Smith Innovation, 2016. *På Kanten*, Realdania. Available at: www.test-din-baeredygtige-loesning.dk.
UN Environment & International Energy Agency, 2017. *Towards a zero-emission, efficient, and resilient buildings and construction sector. Global Status Report 2017*, Global Alliance for Buildings and Construction.
Van de Ven, A.. et al., 1999. *The innovation journey*, Oxford University Press.
Weatherbee, T.G., 2010. Critical Incident Case Study. In A. J. Mills, G. Durepos, & E. Wiebe, eds. *Encyclopedia of Case Study Research*. SAGE Publications, Inc., pp. 248–249.
Yin, R.K., 2014. *Case study research : design and methods* Fifth edit., Thousand Oaks, California: SAGE Publications, Inc.